

Question 1

The time-independent Schrödinger equation for a free particle is

$$-\frac{\hbar^2}{2m} \frac{d^2\psi}{dx^2} = E\psi$$

Possible solutions are:

$$\psi(x) = Ae^{ikx} \quad \text{and} \quad \psi(x) = Ae^{-ikx}$$

where $k \geq 0$.

Which of the following is true about the momentum of the particle p ?

1. For each of these solutions $p = +\hbar k$.
2. For each of these solutions $p = -\hbar k$.
3. For each of these solutions $p = +k/\hbar$.
4. For each of these solutions $p = -k/\hbar$.
5. For each of these solutions $p = +\hbar k$ or $p = -\hbar k$ is possible.
6. For each of these solutions $p = +k/\hbar$ or $p = -k/\hbar$ is possible.

Question 2

For particles incident from the left on a step potential

$$\psi_I(x) = Ae^{ikx} + Be^{-ikx}$$

$$\psi_I(x) = Ce^{ik'x}$$

The boundary matching conditions are:

1. $A = B = C$.
2. $A + B = C$ and $A - B = -C$.
3. $A + B = C$ and $k(A - B) = k'C$.
4. $A + B = C$ and $k(A - B) = -k'C$.